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# Current trend for maxillary implant overdenture

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The purpose of this review was to provide the current research trend for the maxillary implant overdenture, and to provide an update of recent research focused on the numbers of implants and attachment types. A literature search was conducted on the maxillary overdenture research which was published during 2020. We excluded studies that contained tooth-supported overdenture and denture fabrication, or designed a case report or pilot study. After screening the title, abstract, and full-text, sixteen studies were included for this review. Although many studies were tried to reduce the numbers of implants, in conclusion, four regular implants with proper attachment systems are still recommended for the overdenture in contemporary dentistry with proper attachment systems, excepting magnet attachment. (JOURNAL OF DENTAL IMPLANT RESEARCH 2021;40(2):54-58)

**Key Words:** Attachment, Dental implant, Denture, Overdenture, Review

## INTRODUCTION

Since Brånemark introduced the osseointegration of titanium implants in the 1970s<sup>1</sup>, dental implant has become a gold standard that can substitute the conventional denture for tooth loss. However, rehabilitation with fixed implant protheses has inevitable cost problem and surgical trauma for full edentulism due to the large numbers of dental implants. On the other hand, a complete denture is the conventional treatment option of full edentulism, but it cannot rehabilitate sufficient masticatory function.

To overcome these shortcomings, an implant overdenture was introduced since McGill consensus statement in 2002<sup>2-4</sup>. An implant overdenture can provide an alternative result in patient satisfaction and retention for the rehabilitation of edentulous patients compared with complete denture, and require fewer implants, resulting in a lower cost, less surgical trauma and more rapid completion of the rehabilitation compared with fixed im-

plant-supported complete dentures<sup>5</sup>. Nevertheless, low survival rates of the implant have been reported on the maxillary overdenture supported with less than four implants placement<sup>6</sup>. And the optimal numbers of implant remains controversial for the maxillary overdenture<sup>7</sup>. Many research has been conducted to reduce the number of implant placement for maxillary and mandibular overdenture.

Although clinical studies have reported the high survival rate of the implants that support overdentures, the prosthetic complication rates could be high during the maintenance, especially when associated with loss of retention of the overdenture attachments<sup>8,9</sup>. For the overdenture, several attachment types have been proposed to improve retention and stabilization with different cost, biomechanics, longevity, functionality, and patient comfort<sup>10-12</sup>.

The most common attachment types have been suggested the bar, stud, and magnetic attachment systems. Generally, The bar and clip systems show rigid retention

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depending on the shape of the transverse section and the clip material composition, but loss of retention has been reported due to repeated detachment and biofilm accumulation<sup>13,14</sup>. The ball and O-ring attachment systems are resilient, and the polymeric retention ring allows for stress relief for the implants, but show a high rate of maintenance problems or need to change the attachments over time<sup>15,16</sup>.

With regarding implant overdenture, there are still unclear the optimal numbers of the implant and selection of attachment systems. Therefore, the purpose of this review was to present the up-to-date research for the maxillary implant overdenture focused on the numbers of implants and attachment types.

## SELECTED ARTICLES

This review of literature included clinical and in vitro studies published in 2020, related with the implant overdenture. The Google scholar and PubMed were searched in January 2021 using the key word as overdenture. We excluded studies that contained tooth-supported overdenture and fabrication method, or designed a case report or pilot study, and did not published in English. Of total 1,626 searched articles, we enrolled 67 studies within the criteria. Sixteen research were reported on maxillary implant overdenture (Fig. 1).

## MAXILLARY IMPLANT OVERDENTURE

Kelly and McKenna reported a systemic review including the studies for patient satisfaction and oral health-related quality of life as outcome measures during 1946~2018<sup>17</sup>. They analyzed eight reviews and highlighted the greater benefits of the overdenture compared with the conventional dentures when assessing patient satisfaction and oral health-related quality of life. Saravi et al. showed another systemic review to compare the marginal bone loss around implants of the overdenture and fixed prosthesis<sup>18</sup>. Through 42 full-text articles, the implant supporting both types of prosthesis was showed similar long-term outcomes (1~10 years) regarding marginal bone loss.

With regarding the satisfaction, the overdenture could be provided comparable patient satisfaction, masticatory function, and oral health-related quality of life to those with implant supported fixed prosthesis<sup>19</sup>. Doorne et al.<sup>20</sup> reported that 204 one-piece mini-implant (2.4 mm in diameter) for maxillary overdenture showed oral health-related quality of life improvement when at least 5 implants, preserving functional comfort. Doorne et al.<sup>21</sup> reported another clinical prospective multicenter cohort study for 2.4 mm mini-implant supported overdenture. They showed Kaplan-Meier survival rate of 86.3% (6 months), 84.0% (1 year), and 82.3% (2 years). Although higher MDI failure in the maxilla compared to the man-

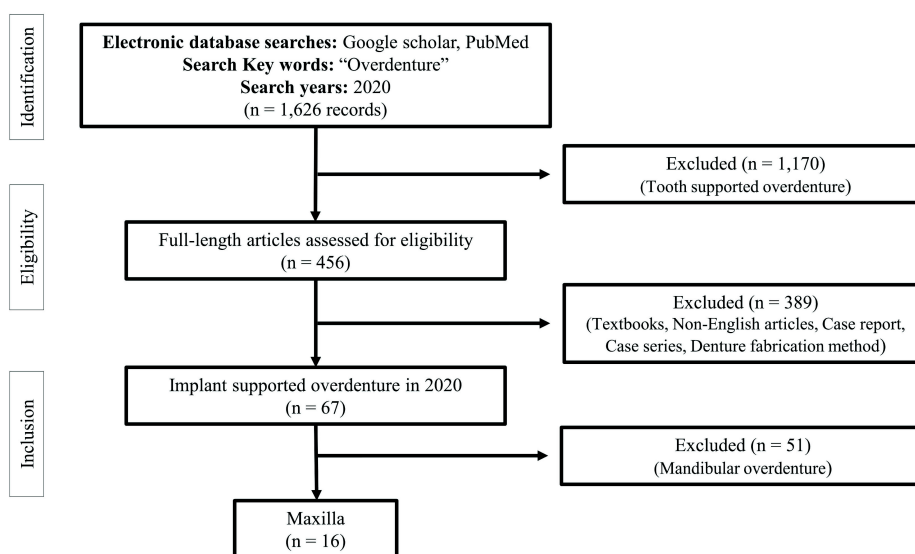


Fig. 1. Flow chart for review process.

dibular overdenture, 96% of the patients was felt satisfaction of this treatment. But the patients who experience complications such as screw loosening and repair of the prosthesis was reported lower satisfaction than who did not<sup>22)</sup>. Therefore, the superiority of implant retained overdentures was most evident when patients cannot tolerate conventional complete dentures.

## NUMBERS OF IMPLANT

Two systematic review were reported the numbers of implant for the maxillary overdenture<sup>6,23)</sup>. Kern et al.<sup>6)</sup> conducted a systematic literature search for randomized-controlled trials or prospective studies within an almost 20-year period (1996~2013). Fifty-four studies were qualitatively analyzed and concluded that the implant loss rates on <4 implants were higher than for four implants (7.22 [95% confidential interval, CI, 5.41; 9.64] vs. 2.31 [1.56; 3.42];  $P < 0.001$ ). In addition, estimated 5-year survival rates of implants were 97.9% [95% CI 97.4; 98.4] in the maxilla, and corresponding implant loss rates were higher in the maxilla (0.42% [95% CI 0.33; 0.53]) than the fixed restorations (0.23% [95% CI 0.18; 0.29]). Guenin and Martin-Cabezas searched on PubMed and EMBASE databases from 2000 to 2017, and performed a meta-analysis with 28 researches for implant failure between four splinted implants and more than four splinted implants<sup>23)</sup>. The implant survival rate was higher when at last four implants were supported to the overdenture compared to less than four implants, and the survival rate was not significantly difference between the four implants and more than 4 implants overdentures (odd ratio=0.39; 95 % CI: 0.14, 1.14;  $P=0.09$ ). However, patient satisfaction was not different according to the number of implants. But the maxillary overdenture with five or six mini-implants (2.4 mm in diameter, 10 or 11.5 mm in length) were showed substantial failure rate of 17.0% during 2-years of function<sup>24)</sup>.

Using four edentulous maxillary educational acrylic resin models, Hegazy et al.<sup>25)</sup> investigated to the stresses and retention of maxillary palateless implant-supported overdenture. They experimented two or four implants with different attachments, and showed superior stress distribution with 4-implants than 2-implants overdenture

and insignificant retentive forces among the groups. On the peri-implant mucosa response, Baskaradoss et al.<sup>26)</sup> conducted a systematic review for the effects of the implant numbers and loading protocols, and found that the deep pocket depth around dental implant for the overdenture was related with immediate loading protocol rather than the numbers of implant.

With minimally four splinted implants, the maxillary overdenture was showed stable clinical outcomes. On the other hand, Bouhy et al.<sup>27)</sup> evaluated the four un-splinted implants with study abutments for maxillary overdenture. The patients had natural teeth or a fixed rehabilitation in the mandible. After a follow-up period of 1 year, implant survival rate of 86.2% and the prosthesis survival rate was 96.6%. Despite of the implant survival rate was lower compared with previous literature, patient satisfaction was significantly improved compared to conventional dentures.

## ATTACHMENT SYSTEMS

There has been proposed several attachment systems for the implant overdenture. In general, the bar attachment has moderate tissue reaction, resulting in the mucosal changes, gingival inflammation, and bone resorption. The locator attachment shows high risk for maintenance and repair problems. The magnetic attachment contributes higher bone resorption rate and lower retention resistance under functional movement.

A systematic review and meta-analysis was conducted for the attachments used in implant-supported overdenture, including the combination of bar and ball attachments and their subtypes, magnetic and bar attachments, and locator in combination with other attachments.<sup>28)</sup> Although these results was mixed with mandibular overdenture, the survival rate of attachments was in the range of 96.2~100% for ball, 97% for locator, 95.8~97.5% for bar, and 90~92% for magnet attachment after 3 years of follow-up period. Patient satisfaction was higher in ball, locator, and bar attachments than magnetic attachment. Therefore, they recommended both of ball and locator attachments in terms of survival rate, tissue response, and patient satisfaction. Another systematic review for the peri-implant mucosa response was showed that the at-

tachment types, such as telescopic, bar or locator system, were not affected the deep peri-implant pocket<sup>26)</sup>.

With comparing bar-clip or ball attachments, Chrcanovic et al.<sup>29)</sup> researched 36 implant-supported maxillary overdentures. Both attachments were showed similar outcomes in survival, success, and complication rates. The complications were related opposed dentition. The patients with natural dentition or fixed prostheses on mandible showed with more complications on the maxillary overdenture.

Ferrer et al.<sup>30)</sup> was conducted a prospective observational cohort study to compare long-term (average 11.4 years) mechanical behavior of the maxillary overdentures with locator and bar attachments. Both attachments were showed similar implant survival rate (72.5% and 80.0%, respectively) and patient satisfaction (7.9 and 8.8, respectively). But prosthetic complications were more frequent in locator than bar attachments (30% and 10%, respectively) with different aspect. The prosthetic complications of locator attachment were showed 100% loss of retention (per every 3 years), 40% of insertion path change (per 3~8 years), 40% resin fracture (per 6 months-8 years) 30% denture repair (relining per 2~8 years), and 20% denture fracture (per 5~8 years), in order. The complications of bar attachment were showed 30% loss of retention (per 6~10 years) and 20% screw problems (per 3~4 years), denture fracture (per 3~4 years), and denture wear (per 7~8 years). Thus, the prosthetic complications of locator attachment could be solved more simply than that of bar attachment. In conclusion, both attachment systems were shown acceptable long-term outcomes with a high level of patient satisfaction.

There were some in-vivo studies for evaluating the retention of attachment system. Hegazy et al.<sup>25)</sup> experimented two or four implants with different locator or OT equator attachments, suggested that the maxillary overdenture with four locator attachment with either two or four implants considering their superior retentive properties when compared to OT equator attachments. Wichmann et al.<sup>31)</sup> investigate the retentive properties of three different resin matrix attachments for implant overdentures with either polyetheretherketone inserts (PEEK), polyetherketoneketone inserts (PEKK) or nylon inserts

(Locator R-Tx). All attachment systems showed a high variability of the retentive forces for subsequent cycles, and PEEK and PEKK attachments combined with titanium matrices were showed favorable for long-term use, both for orthogonal and tilted implants (0~15°).

## SUMMARY

Implant supported maxillary overdenture showed superior outcome compared with conventional complete denture, and comparable cost-effective results compared with implant supported fixed-denture. Although many researches tried to reduce the numbers of implant, four regular implants are still recommended to achieve stable clinical outcome for the overdenture in contemporary dentistry with proper attachment systems, excepting magnet attachment.

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